

**University of California**  
Agriculture and Natural Resources

Making a Difference for California



**UCDAVIS**  
**VETERINARY MEDICINE**

# **Improving Efficiencies on Dairies: Opportunities through Feeding Management**

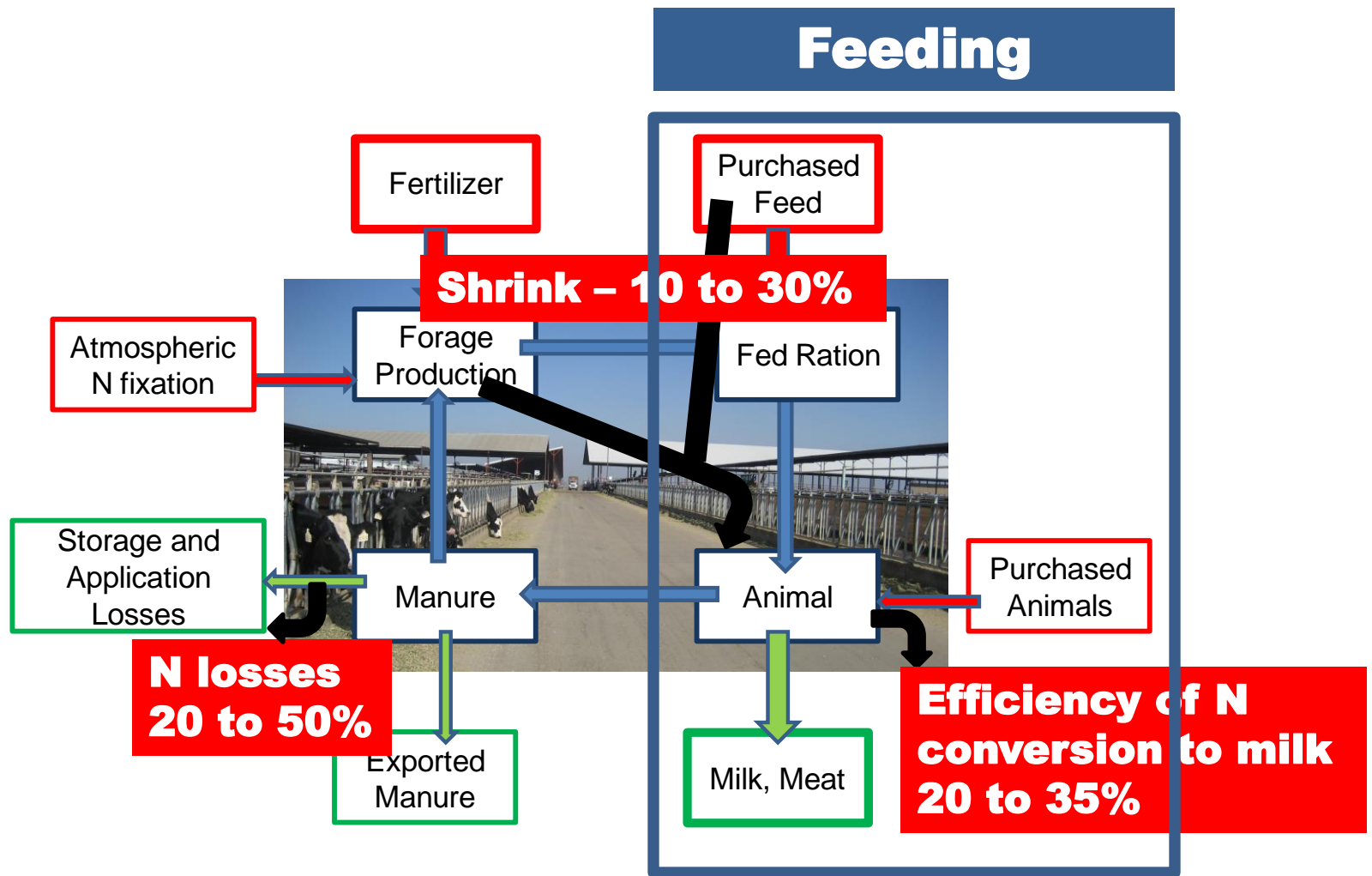
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**Noelia Silva-del-Río, DVM, PhD**  
**CE Dairy Specialist**  
**UC Davis Vet Med - VMTRC**



# Environmental Concerns of Livestock Production

<b>Greenhouse Gases</b>	<b>CO<sub>2</sub>, CH<sub>4</sub>, N<sub>2</sub>O...</b>
<b>Nutrients</b>	<b>N, P, K...</b>
<b>Pathogens</b>	<b>E. coli, Salmonella, toxins...</b>
<b>Toxic Substances</b>	<b>H<sub>2</sub>S, heavy metals, drugs...</b>
<b>Alteration of Ecosystems</b>	<b>Deforestation, Landscape changes...</b>
<b>Odor Emissions</b>	<b>VOCs, H<sub>2</sub>S, NH<sub>3</sub>...</b>



**Nitrogen Cycle in a Dairy Farm**

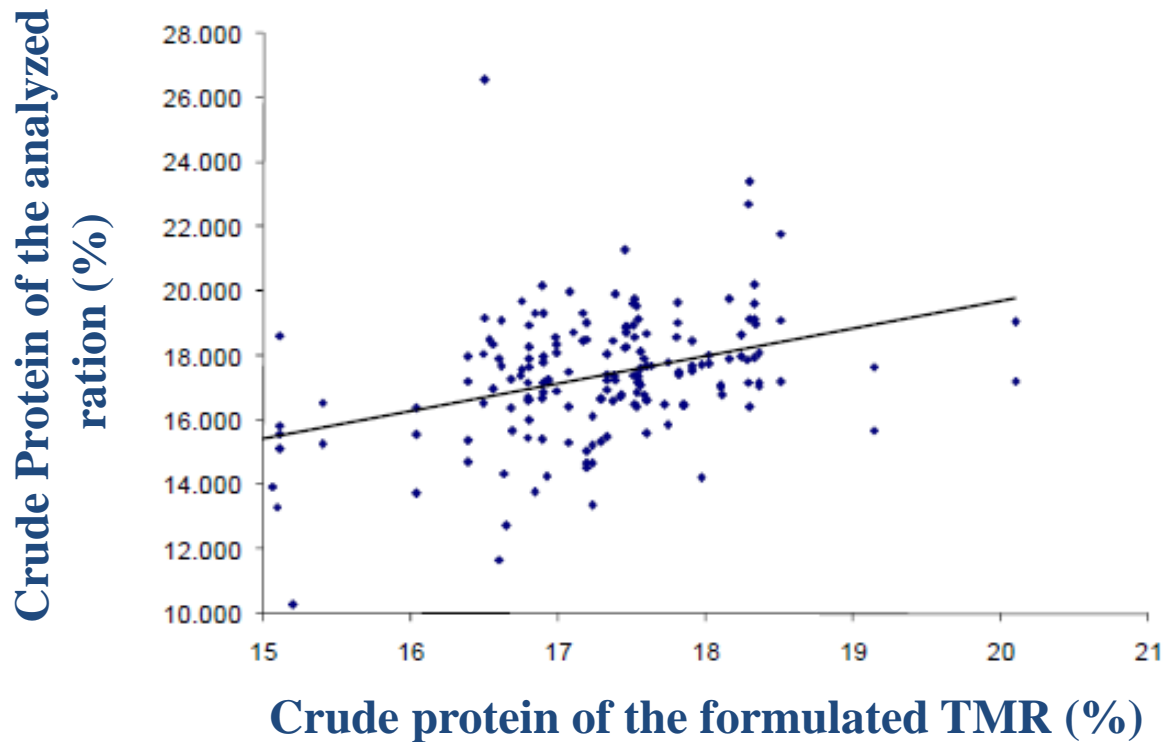
# Feeding Strategies

- Optimize Microbial Protein
  - Balance Rumen Degradable Protein / Rumen Undegradable Protein; Provide Energy
- Feed Rumen Undegradable Protein with Complementary Amino Acid Profile
- Dietary Crude Protein Can be Reduced to ~16.5%
  
- Do Not Over-Feed CP
  - Track feedstuff changes in CP & DM

**Ration  
Formulation**

**Feeding  
Management**

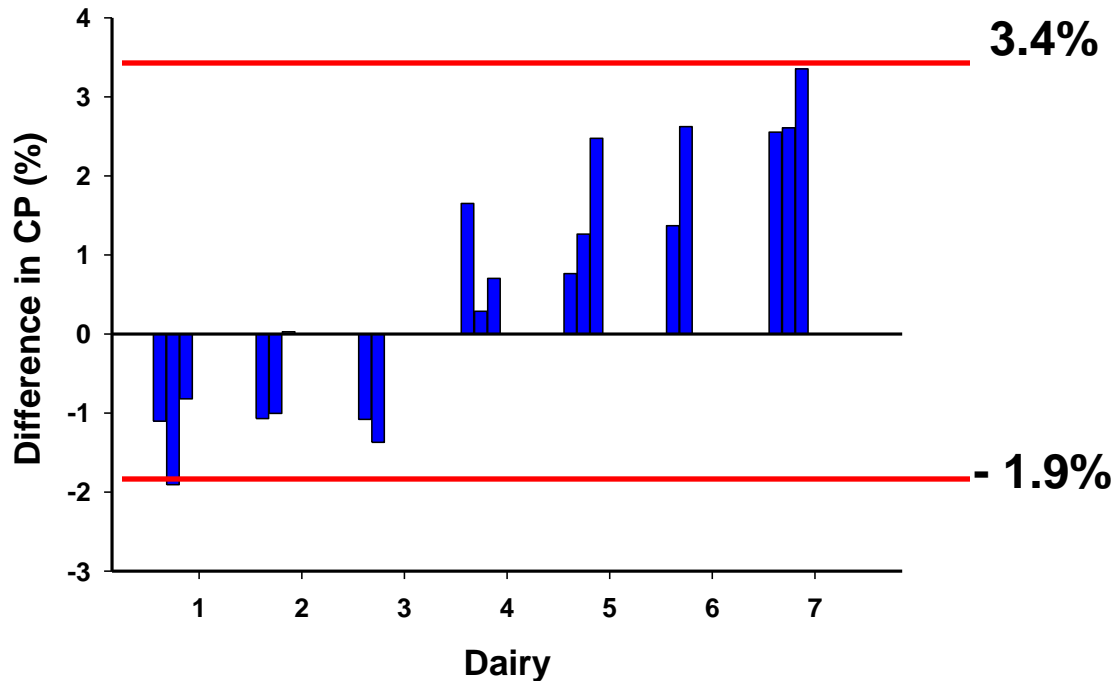
# Formulated vs Analyzed CP



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Correlation between the crude protein of the formulated and the analyzed ration in 15 Virginia dairies over a one year period (James and Cox, 2008;  $r=0.45$ ;  $P = 0.55$ ).

# Formulated vs Analyzed CP



Difference in percentage units of crude protein (CP) between the formulated and the analyzed CP in seven dairies in Merced County (Silva-del-Rio and Castillo, 2012).

The nutritionist may carefully formulate rations to accurately meet animal requirements...

ADM Alliance Nutrition - Consulting Nutritionist - ADM Alliance Nutrition - [Rations - GP 3 and 4]

ADM ANI Dairy Requirements 'GP 3 and 4'

Customer: Rat

Inputs: Evaluation

BP 3 and 4	Current AF	Current DM	AF Amt	DM Amt
CDRN SILAG	40.80	15.30	40.80	15.30
CDRN SILAG	17.35	6.50	17.35	6.50
WET BREW	11.74	3.12	11.74	3.12
Conc. Tit Fe	9.17	8.48	9.17	8.48
CDRN GRO	7.14	6.18	7.14	6.18
YBEAN MEAL	6.11	5.44	6.11	5.44
W. HAY	4.10	3.58	4.10	3.58
TIMOTHY HA	3.07	2.70	3.07	2.70
WHOLE COT	2.64	2.40	2.64	2.40
<b>Total</b>	<b>101.51</b>	<b>63.70</b>	<b>101.51</b>	<b>63.70</b>

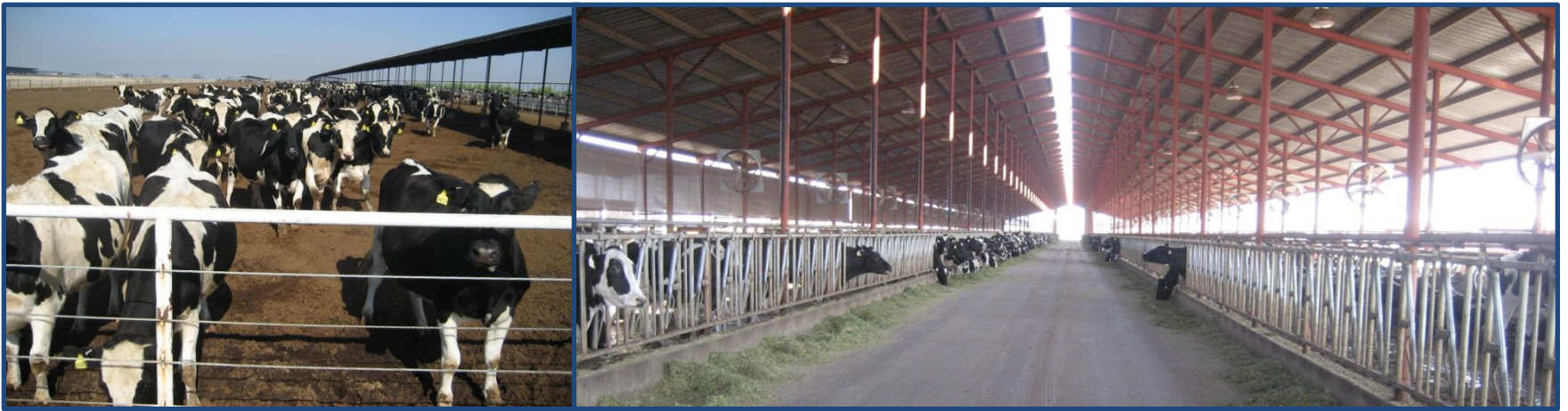
Adjustment Ingredient: None  
Select Columns: AF Amt + DM Amt

Version: DairyADM 1.007.035.001 (September 19, 2005)

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The dairy may have multiple production groups (high-medium-low) to adjust the ration to animal requirements,.....





But, we will not improve the **efficiency of nutrient utilization** unless:

Industry accepted **feeding management practices** are implemented to minimize the variation between the formulated and fed ration.



# Different Diets in a Dairy

**Formulated diet** – prepared by nutritionist

**Working diet** – modified by the true nutrient content of ingredients

**Fed diet** – modified by the feeder when weighing ingredients, mixing efficiency of mixer wagon,...

**Consumed diet** – modified by cow sorting behavior

**Digested diet** – modified by digestion (i.e processing)



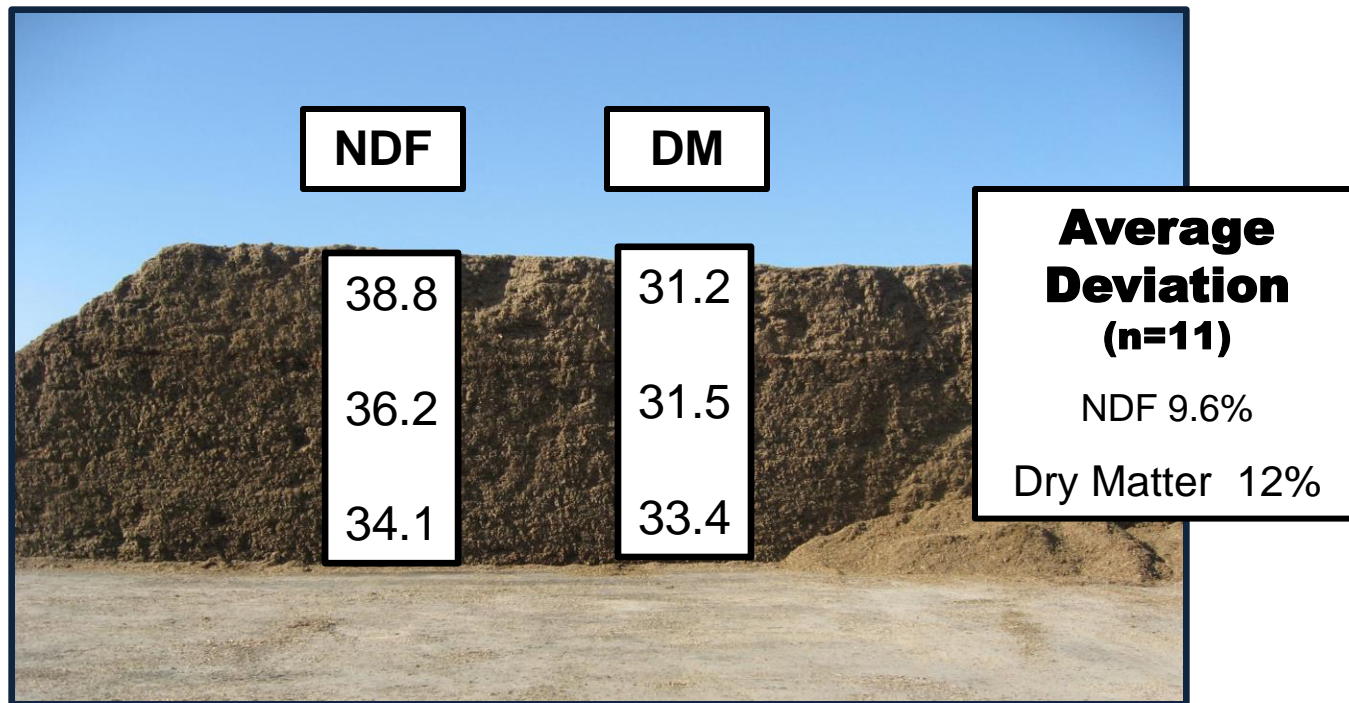
# Uncertainties in Nutrient Composition of Ingredients





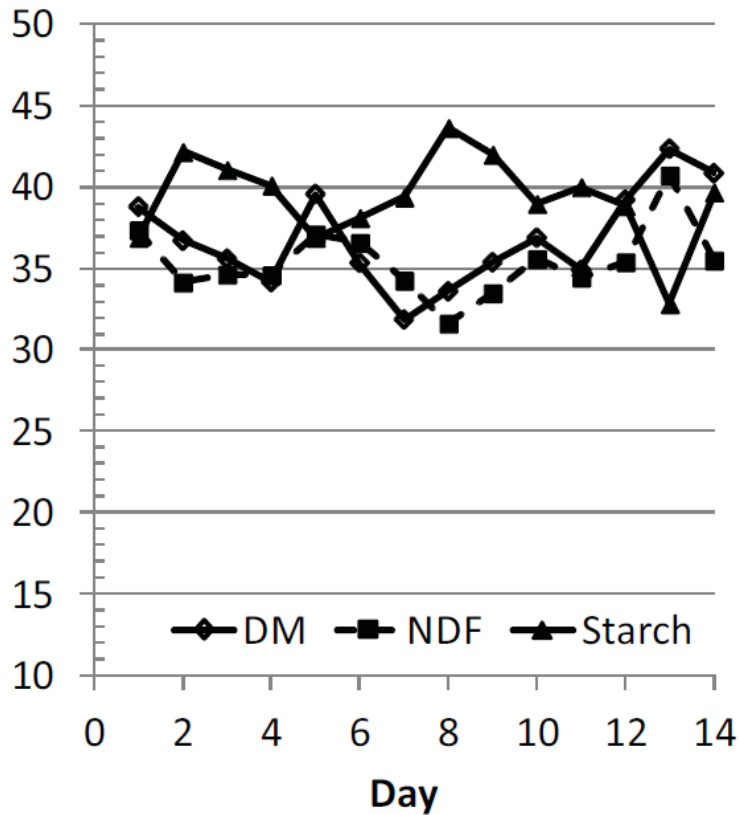
# Variation in Nutrient Content: Sampling Methodology

## Silage



There is variation in nutrient composition across the top, middle and bottom of the corn silage structure.

# Day to Day Variation in Nutrient Content



	DM (%)	NDF (%)	Starch (%)
Mean	38.8	40.4	31.7
SD	2.1	2.5	3.0
CV	5.3	6.2	9.5
Range	7.3	8.8	12.2



Day to day changes in DM, NDF, Starch (%) in corn silage [Figure (n=1), Table (n=8) (Weiss et al., 2012)].

# Long Term Variation in Nutrient Content

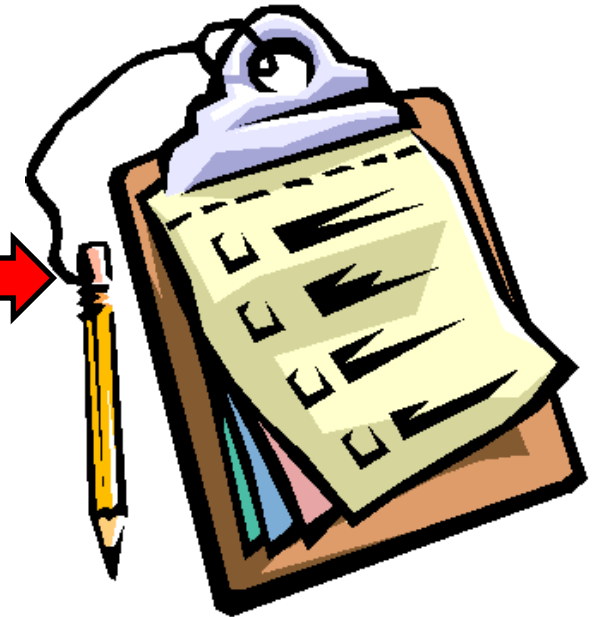
	DM (%)	CP (%)	NDF (%)
Mean	29.9 - 43.1	6.8-11.8	35.1-51.2
SD	0.8-5.0	0.24-1.27	1.2-6.5
CV	2.5-17.9	0.8-4.7	4.1-22.1



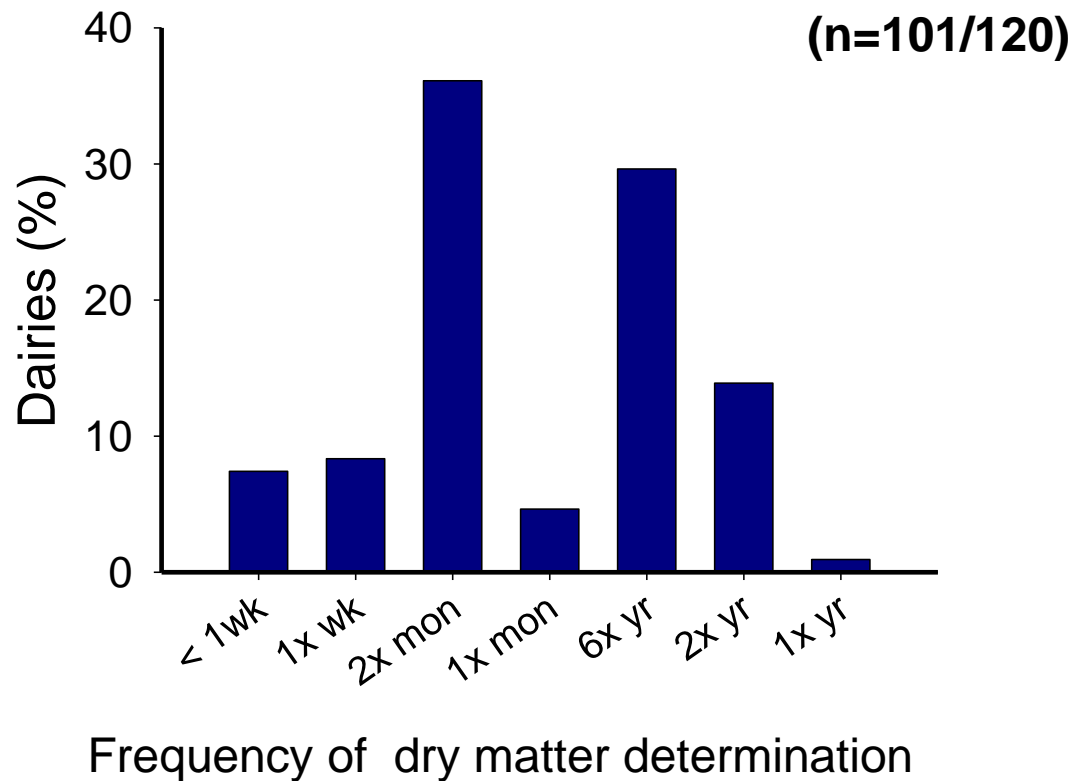
Variation in nutrient composition of corn silage within dairy (n=48) over a 12 month period (Weiss et al., 2012)

# Weighing Ingredients

## Adjust the as-fed weights by the new DM



# How often do you evaluate corn silage dry matter?



Corn silage dry matter was conducted at least once a month in 52.3% of dairies. Only 8.3% of dairies determined DM weekly, or more often



# Variation in Dry Matter at Harvest



Trucks = 101  
Average Dry Matter = 29.9%  
SD = 2.1  
Minimum = 24.6%  
Maximum = 35.3%

Heguy et al., 2010 - Abstract ADSA



## **What explains this variation?**

- Varieties
- Irrigation
- Slope
- Soil type
- Pests
- Sampling error

# Opportunities

- Determine the variation in nutrient composition of common feeds on commercial dairy farms and its impact on TMR nutrient composition and dairy cow production.

The Ohio State University  
Animal Science and Extension  
National Research Initiative Competitive Grant USDA

# Opportunities

- Develop and evaluate strategies to mitigate ensiled forages variability

For example: at the silage pit separate trucks with different dry matter



Low Moisture Pile



High Moisture Pile





# Opportunities


- Develop educational materials on how to take a representative sample, how to do on-farm dry matter, etc.

**Dry Matter Determination of the Corn Crop Prior to Harvest**  
*Noelia Silva-del-Rio, UCCE Tulare County, Dennis Craig and Vernal Gomes of Mycogen*


The dry matter of the crop standing in the field can be estimated by evaluating the greenery of the canopy, breaking down the stalk and examining the kernel milk line. But, how well does that relate to actual dry matter? We suggest you to take a new approach that may help you to more accurately determine the dry matter of the crop standing in the field.

 <p><b>Step 1.</b> Take a representative sample of the field. <b>Select 10-20 plants</b> at different locations away from the head or tail of the field. Enter the field several rows from the edge. You can use a machete or pruning shears.</p>	 <p><b>Step 2.</b> Hand feed the plant to a <b>chopper</b> (you can use a chipper shredder). Place a bag to collect the chopped material.</p>
 <p><b>Step 3.</b> Take a <b>representative sample</b>: <b>Method 1</b> (more accurate): divide your sample in quarters and discard two opposite quarters. Mix the other two quarters and repeat until you get a 1lb sample, or volume of 5-7 cups. <b>Method 2:</b> Mix the pile well and collect 5-7 cups of forage throughout the pile.</p>	 <p><b>Step 4.</b> Place your sample in a <b>plastic bag</b> and keep on <b>ice</b>. Take the sample quickly to a lab or to your dairy for dry matter determination. It is important to get the wet weight as soon as possible.</p>
 <p><b>Step 5.</b> Use approximately <b>100 g</b> for <b>microwave method</b> or <b>200 g</b> for <b>Koster Tester</b> (1lb = 454 g). You may also find a nearby lab where you can get timely results.</p>	


**Dairy 1**  
In this dairy, the silage face management is poor. The front loader lifts the silage from bottom top allowing oxygen to enter the face.



**Dairy 2**  
In this silage the face is smooth and perpendicular to the floor. The face is carefully shaved side by side the face.



**Dairy 3**  
This dairy uses a face shaver. It is estimated that face shavers can reduce DM losses by 3% compare to a front-end loader. However, more research needs to be conducted.



# Different Diets in a Dairy

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# Challenges Preparing the Total Mix Ration



# Weighting Ingredients

## Feeder Skills

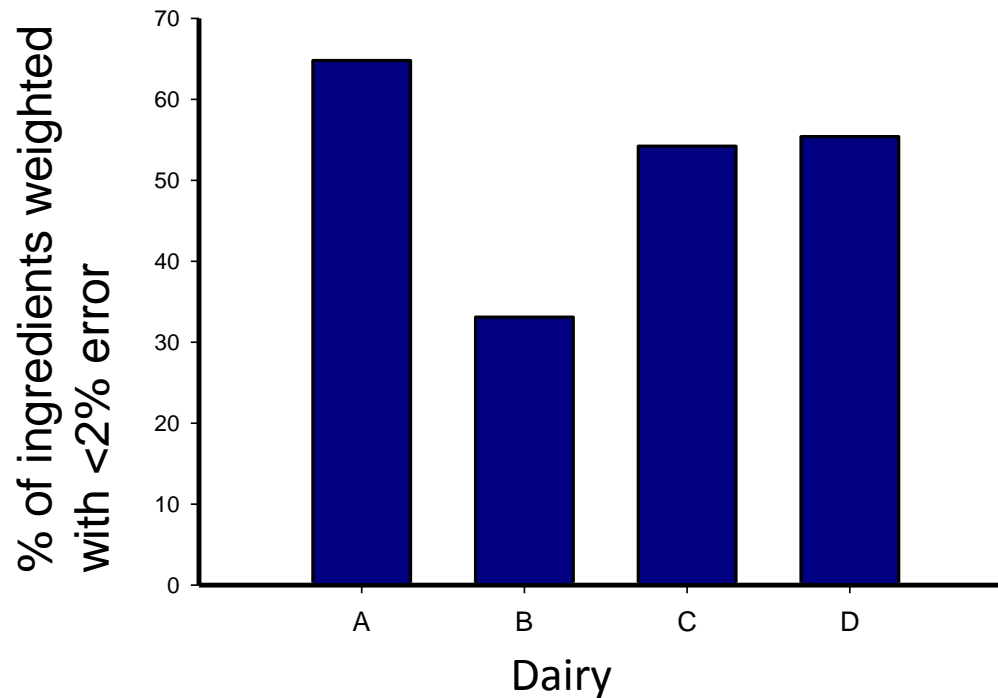
Industry wide is accepted weighing errors of  $\pm 2\%$

- Difficult to weigh (i.e. hay)
- Added in small quantities (i.e. minerals)

How are our feeders performing?



# Weighting Ingredients Feeder Skills



In Dairy A 65% of the weights had an error of < 2% and in Dairy B 33%.



# Weighting Ingredients

## Scale Calibration



Are the mixer wagon scales reading correctly?  
How frequently are the scales calibrated?

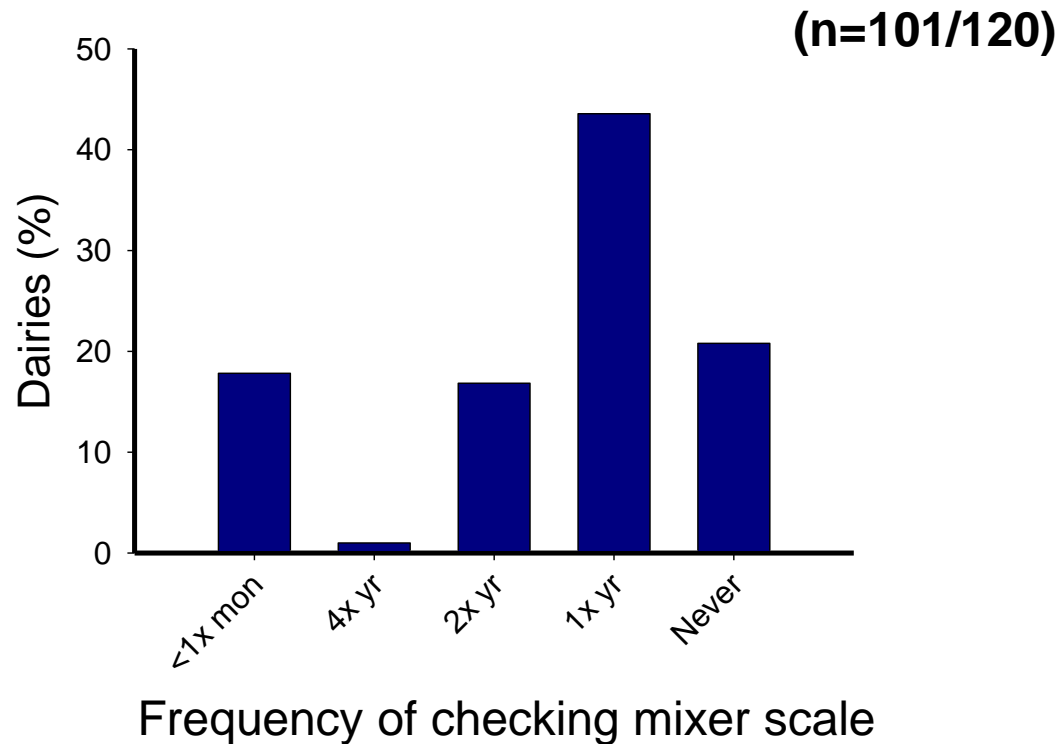


Picture Source: Carol Collar



Picture Source: Dr Oelberg

# How often do you calibrate the TMR mixer scale?



Seventy-nine percent of producers checked the mixer scale at least once a year. But, only 19 (%) checked it at least monthly. The TMR was calibrated by outside service (60%) or in house employee (40%)

# Chopping and Mixing: Equipment Maintenance



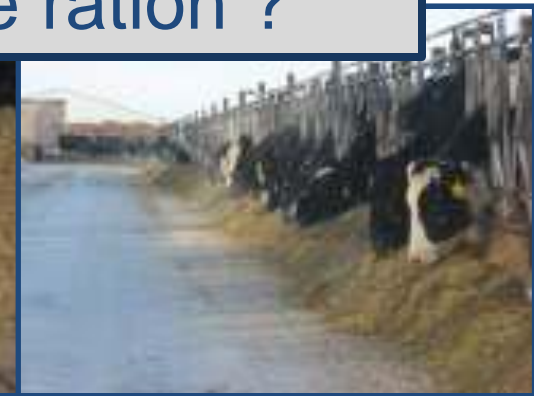
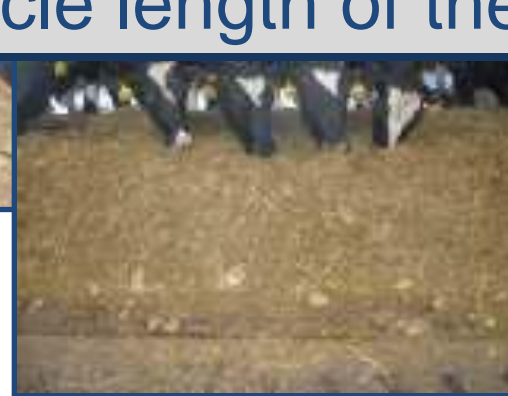
Picture Source: Dr Oelberg with Diamond V

# Chopping and Mixing: Equipment Maintenance

## Before Replacement



How sharp are the knives?  
What is the particle length of the ration ?



Picture Source: Dr Oelberg with Diamond V

# Chopping and Mixing: Equipment Maintenance

**Worn Auger**



**Worn Edge Deflector**



Are the mixer wagons well maintained?

# Chopping and Mixing: Ingredients order

Order of Ingredients based on Physical Properties:

- Particle size
- Shape
- Density
- Water absorption capacity (hygroscopic)
- Static electricity
- Adhesiveness



Are the ingredients added in a  
logical order?





# Chopping and Mixing: Mixing Time

**Excessive mixing time** - insufficient effective fiber.

**Insufficient mixing time** – TMR no uniformly mixed.

Is the mixing time adequate?



# Chopping and Mixing: Size of the Load

Mixing is going to be poor if we overload or underload the mixer wagon

**Overloaded**



**Underloaded**



How many loads are prepared over or under capacity?



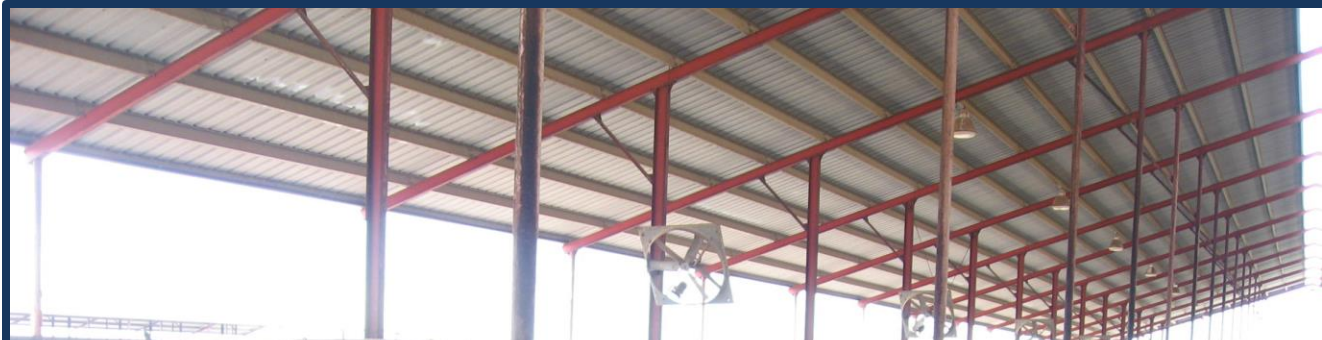
# Dropping TMR



Are the tons/pen dropped closed to target?



# Final TMR



Is the ration fed similar to the formulated?  
Is the TMR uniformly distributed?  
Is the particle length adequate?



# Opportunities

- Describe what are the current management practices in California dairies.
- Evaluate if current feeding management practices are leading to desirable feeding outcomes:
  - TMR analyzed vs formulated
  - TMR mixed uniformly
  - TMR particle length

# Opportunities

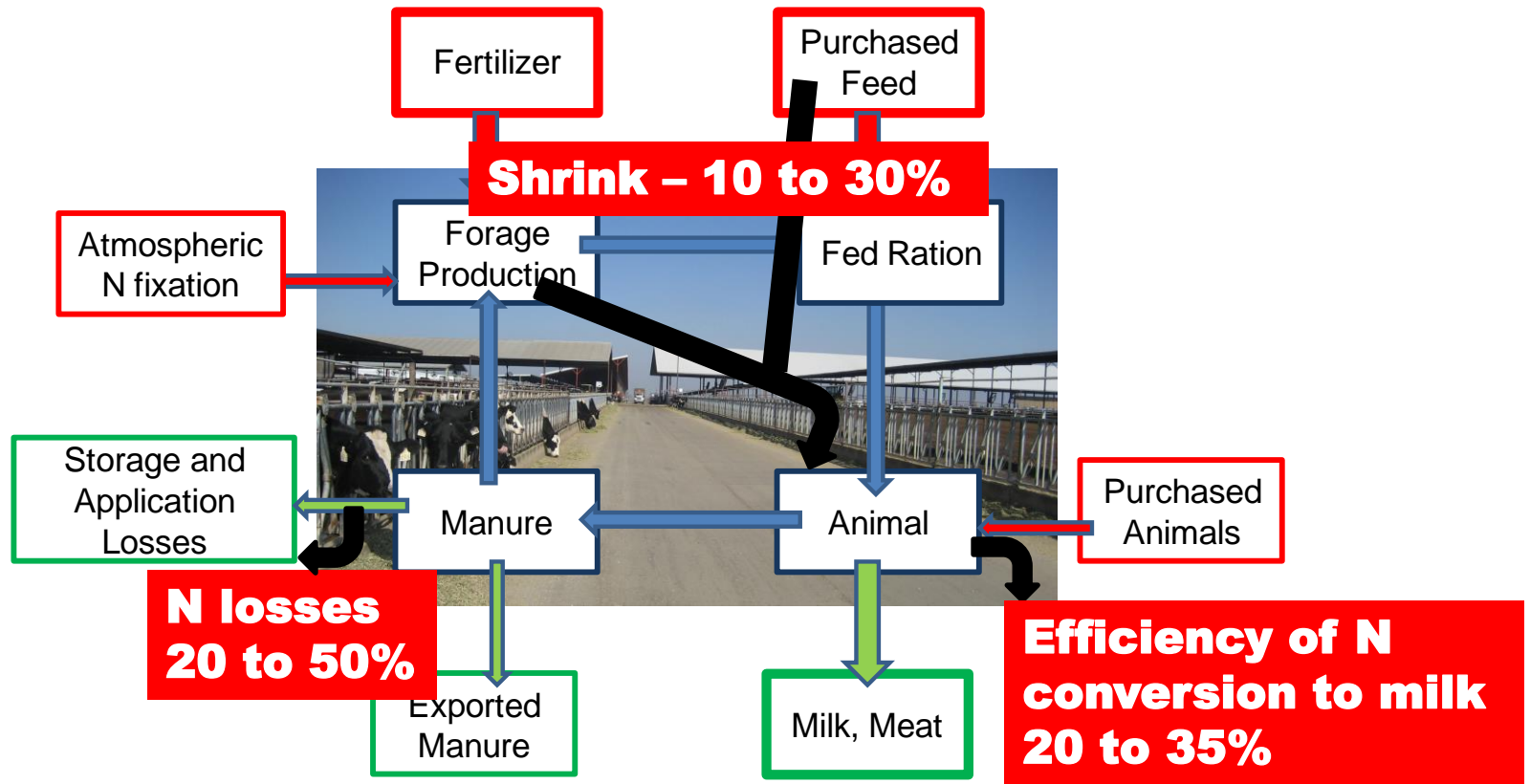
- What explains the difference between TMR analyzed vs formulated?
  - Error associated with nutrient composition of ingredients
  - Error associated with ration preparation and delivery
  
- Evaluate the implications of undesirable feeding outcomes on health and production





# Shrink





**Nitrogen Cycle in a Dairy Farm**

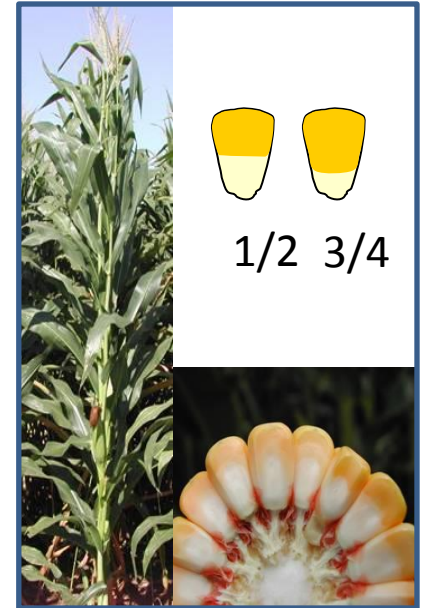
# **Silage Shrink**

**Low pH**

**No Oxygen**

# Silage Shrink: Harvest

## DRY MATTER



## CHOP LENGTH AND PROCESSING





# Silage Shrink: Packing

**PACKING TRACTORS**



**DELIVERY RATE**

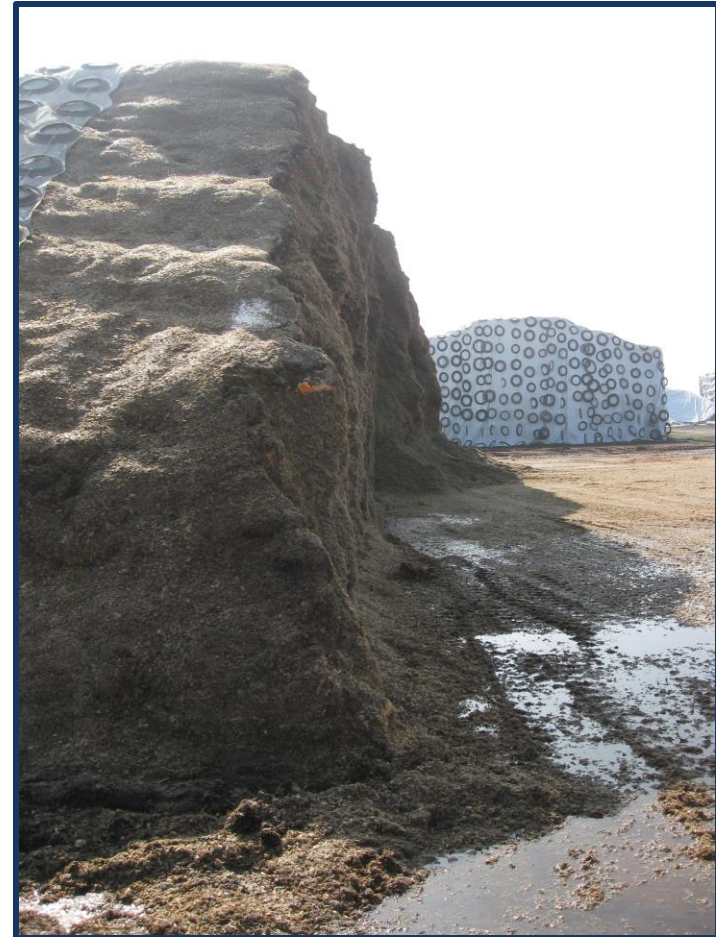


**SIZE OF SILAGE STRUCTURE**



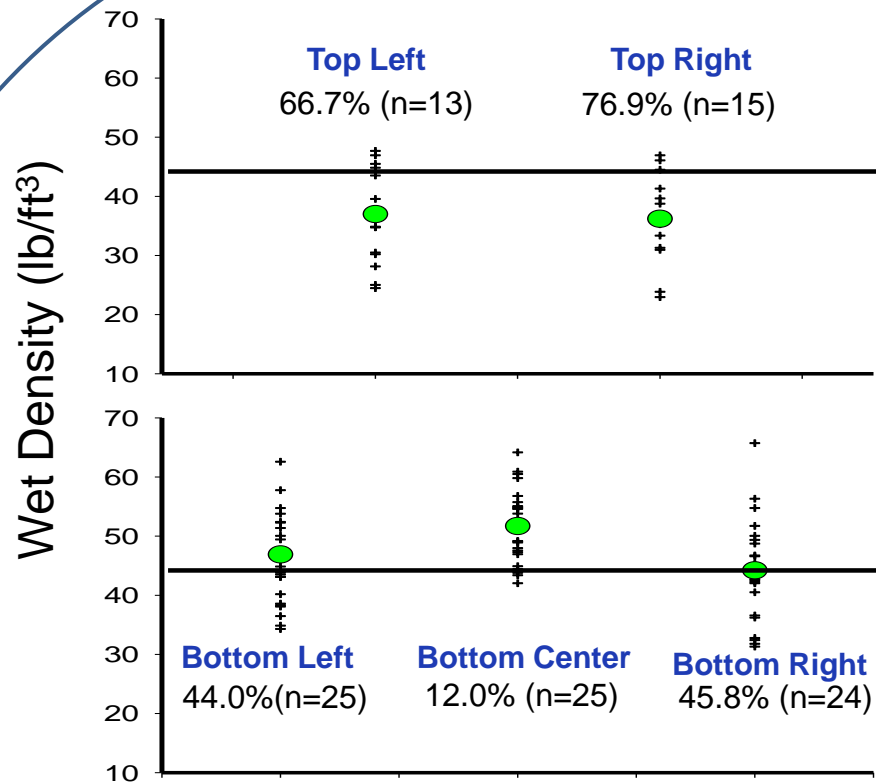
# Silage Shrink: Packing

## PACKING THE SIDES



# Silage Shrink: Packing

## CORN SILAGE DENSITY





# Silage Shrink: Surface spoilage



# Silage Shrink: Surface spoilage





# Silage Shrink: Face spoilage

**MINIMIZE SURFACE AREA**



**SMOOTH FACE**



# Commodity Shrink

# Commodities Shrink



- Uncover Commodities
- Wind
- Birds
- Rodents

# Commodities Shrink

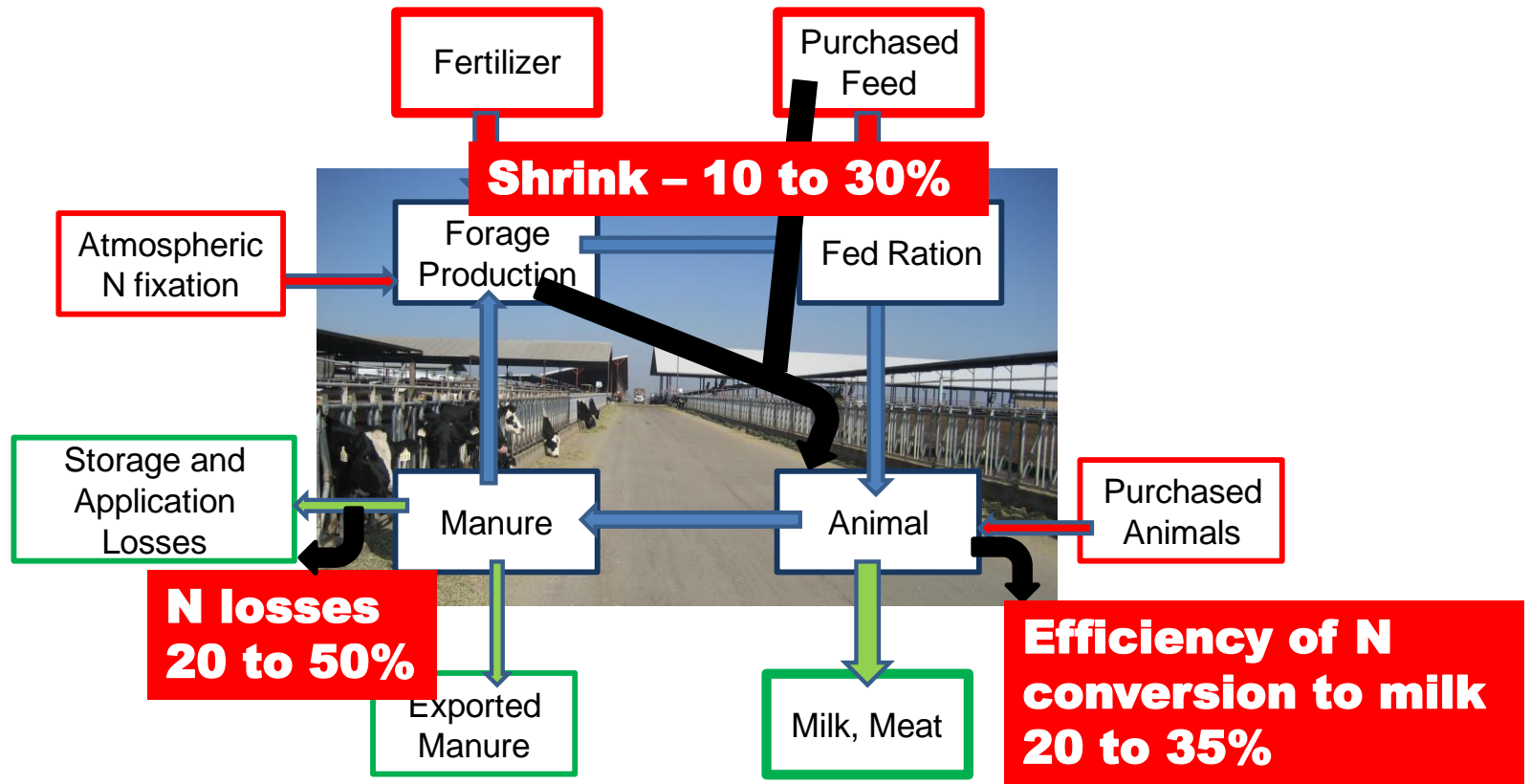


- Commodities delivered in the wrong barn
- Cull fruits seepage
- High moisture commodities next to low moisture commodities

# Opportunities

- Quantify the shrink of forages and commodities
- Evaluate strategies to minimize shrink - conduct on farms demonstrations (i.e. increasing packing of forages, pile over drive, use automatic feeders for minerals,...)
- Develop educational materials (videos) on how to:
  - Deface silage
  - Pack the silage
  - Cover the silage,...





**Nitrogen Cycle in a Dairy Farm**

**Thanks**

